PREVALENCE AND DETERMINANTS OF DEPRESSION AND ANXIETY IN ADOLESCENTS IN RURAL MPUMALANGA, SOUTH AFRICA

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DECLARATION

I, Juliet Wafawanaka hereby declare that I carried out the work contained in this study "*Prevalence and correlates of Depression and Anxiety among adolescents in rural Mpumalanga, South Africa"* submitted for the Masters Of Science in Epidemiology and Biostatistics for The University of The Witwatersrand, Johannesburg, South Africa under the supervision of Dr Ryan G Wagner and Professor Kathleen Kahn. No part of this work has been submitted before for any previous degree or examination at this or any other Institution.

Signed by Juliet Wafawanaka…… Student No. 1029931

November 3rd 2022

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ABSTRACT

Background: An estimated 13% of the global adolescent population is struggling with mental health challenges. Left untreated, these disorders such as depression and anxiety among adolescents may result in school failure, alcohol and other drug abuses, family and community discord and violence and consequently later in life can result in complications such as physical disability, reduced or hindered chances for leading a fulfilling life and difficulty holding a job. There is limited research from rural South Africa which has investigated the prevalence and correlates of self-reported symptoms of depression and anxiety among adolescents thus, this study aims to specifically investigate these correlates among the adolescent population (14-19-years old) from two villages located in rural Mpumalanga, South Africa and hoping its findings will add on to an extensive understanding of the burden and factors of depression and anxiety thereby informing policymakers to develop interventions that may reduce the prevalence of these conditions among the youth.

Methods: The Patient Health Questionnaire-9 (PHQ-9) was used to assess self-reported symptoms of depression, the Generalised Anxiety Disorder-7 (GAD-7) for self-reported symptoms of anxiety. Several possible correlates including demographic (sex, age & education), socioeconomic (living arrangements, socioeconomic quintile & food security status) and psychological factors (time spent on the phone and watching TV) were explored for associations and regressed to the outcomes of depression and anxiety.

Results: Bivariate analysis was conducted and no priori correlate was found to be statistically significant with self-reported symptoms of depression or anxiety. The crude prevalence of self-reported clinically significant symptoms of depression (defined as a score of ≥10 on the PHQ-9) was found to be 11.1%, (95%CI: 7.1 – 15.0%) with females having a prevalence (13.2%;

95%CI: 6.9-19.5%) and males (9.2%; 95%CI: 4.1-14.3%; p= 0.33). The crude prevalence of self-reported clinically significant symptoms of anxiety (defined as a score of ≥9 on the GAD-7) was found to be 5.3% (95%CI: 2.4 - 8.2%), with males reporting a prevalence of 6.2% (95%CI: 2.0 - 10.3%) and females (4.4%; 95%CI: 0.5 - 8.2%; p=0.89).

Discussion: The current study's prevalence of self-reported depression symptoms is in line with previous African and South African studies. The study's prevalence of self-reported symptoms of anxiety is slightly higher than the global estimates. No statistical significance of association was found between *a priori* correlates and the outcome variables; however, a statistically significant relationship between self-reported symptoms of anxiety and self-reported symptoms of depression (p<.001) was found, with 25% of participants reporting to having both, an association that is supported by previous international research in this age group.

Conclusion: This study presents some of the first estimates of the prevalence self-reported symptoms of depression and anxiety in a rural South African adolescent population. Given the inability to generalize these findings, there is a need to replicate it in other similar rural settings. Further research aimed at better understanding the intersection between self-reported symptoms of anxiety and depression and developing health care policies aimed at providing support to adolescents afflicted by these common mental disorders is warranted.

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AGN-FDSCY	Agincourt Food Security Status Form
AGN-HHAST	Agincourt Household Asset Status Form
95%CI	95 percent Confidence Interval
CES-D	Centre for Epidemiological Studies-Depression Scale
CMDs	Common Mental health Disorders
GAD-7	Generalised Anxiety Disorder, 7 item tool
HREC	Human Research Ethics Committee
HDSS	Health and socio-demographic surveillance system
ICD-10	International classification of diseases, Tenth Revision
LMICs	Low and middle income countries
NDAs	Non-Disclosure Agreements
M.I.N.I.-KID	MINI International Neuropsychiatric Interview for children and adolescents
NCDs	Non-communicable diseases
PII	Personal Identifying information
PHQ-9	Patient Health Questionnaire, 9 item tool
PTSD	Post Traumatic Stress Disorder
RedCAP	Research electronic data capture
SCID	Clinical Interview for Depression (SCID) for DSM-1V
SDQ	Strengths and Difficulties questionnaire
SES	Socioeconomic status
SMFQ	Short Moods and feelings Questionnaire
UNESCO	The United Nations Educational, Scientific and Cultural Organization
YLDs	Years of healthy life lost due to disability
YSR	Youth Self Report
WHO	World Health Organisation

CHAPTER 1 INTRODUCTION

1.1 Background study

This chapter presents the background of the current study, issues affecting adolescents' mental health, the problem statement, existing literature on the burden, prevalence and effects of adolescents' mental health. A biopsychosocial framework of mental health tying the *a priori* correlates of depression and anxiety is discussed in relation to this study. The study justification, research question, main and specific objectives of the study are also introduced in the current chapter.

This secondary data analysis seeks to investigate the prevalence and correlates of two common mental health disorders, namely depression and generalised anxiety disorder, among adolescents in rural South Africa. Mental health disorders are a growing problem globally. The World Health Organization (WHO) defines mental health as "a state of well-being in which an individual realises his or her abilities, can cope with the normal stresses of life, can work productively and can make a contribution to his or her community" (WHO., 2014). Mental health disorders, chief among them depression and generalised anxiety, are considered non-communicable diseases (NCDs) and greatly contribute to the global burden of disease. It is estimated that 1 in every 8 (12.5%) (970 million) of the world's population is living with a mental disorder. Among these an estimated 301 million (33.2%) live with anxiety including 58 million adolescents and children. Those living with depression are reported to be 280 million (28.9%) including 23 million adolescents and children (World Health Organization, 2021) With regards to morbidity, depression contributed 7.5% of all years lived with disability (YLDs) in 2015 and generalised anxiety disorders contributed 3.4% of YLDs (ranking 6th in terms of their contribution globally). Fatal suicidal behaviour and/or completed suicide are

some of the most severe outcomes of depression, and contributes close to 800 000 deaths per year globally. Children and adolescents are not immune to mental health disorders and globally it is estimated that 14% of the adolescent population (10-19 years old) suffers from a mental health disorder (World Health Organization, 2017). These disorders, if left untreated, can result in difficulties in school, suicidal ideation and attempts, substance and alcohol abuse, family and community discord as well as violence. Later life effects of untreated depression and anxiety include but are not limited to physical disability, reduced or hindered chances for leading a fulfilling life, social exclusion, suicidal ideation and completed suicide, stigma, discrimination and difficulty holding a job. Completed suicide is reported to be the fourth and sixth leading cause of death among 15-24 years old and 5-14 years old, respectively; hence mental health disorders in youth are of great concern (Pelkonen and Marttunen, 2003). Non-fatal and fatal suicide behaviours can be as a result of alcohol and substance abuse, childhood trauma, stigma associated with mental health disorder, inaccessible health care and social support as well as ease of access to ways to carry out suicide(World Health Organization, 2017).

1.1.1 Adolescents' mental health

The global adolescent population is estimated to be 1.2 billion; almost 16% of the world's total population of 7.5 billion. In sub-Saharan Africa, 50% of the population is below the age of 18 years (Anthony *et al.*, 2017). There is strong evidence of children developing mental health disorders during adolescence (Chandrashekarappa et al., 2016) and as such, this study seeks to add to the understanding of the burden of depression and generalised anxiety among rural South African adolescents.

Adolescence is a period of physical, emotional and psychological development which takes place between childhood and adulthood (Patton *et al.,* 2018). The process of adolescence normally occurs between 10 and 19 years (Leddy et al., 2008) and is a crucial period when psychosocial and cognitive development takes place. The change to adolescence from childhood presents a vast array of challenges that include adapting physical appearance, learning to manage emotions, developing coping and problem-solving skills, as well as managing interpersonal skills (Bandura, 2006). On interpersonal relations, adolescents are expected to conform with peers as well as society while at the same time exploring and defining their own identity. All of these transitions can bring about strain (De Bruyn, 2005). Some adolescents also start relationships, which can result in unwanted, teenage pregnancies and the responsibility of having to take care of another human being before they are fully mature and equipped to undertake the role of parenthood.

The challenge of high HIV prevalence, low socioeconomic status, immigration status and interpersonal violence are also among the factors associated with poor mental health among the rural South African population, compounded by the lack of child and adolescent mental health interventions. The above holds for Agincourt adolescents who are from homes with poor infrastructure, poverty (with the majority living off the government social grants), migrant parents coupled with a high prevalence of HIV infections (Gómez-Olivé *et al.*, 2013; Stoner *et al.*, 2021).

Future interventions aimed at improving mental health literacy among adolescents will equip them to better recognize onset, symptoms and seek interventions timeously to prevent complications (Attygalle, et al., 2017). There is a dearth of research covering the correlates and prevalence of common mental health disorders among South African youth (Das-Munshi *et al.,* 2016) and understanding the prevalence and correlates of these conditions among rural adolescents will contribute to the development of targeted interventions aimed at mitigating

this burden. Timely interventions may significantly reduce the mental health burden among adolescents and consequently associated future complications.

1.2 Statement of the problem

Almost two-thirds of the world's countries have no empirical data on mental health and for those that do, one-third have no data on adolescents' mental health (WHO, 2011). Data from low- and middle-income countries (LMICs) are scarce and most studies on mental health in LMICs are from a few studies, which likely lack reliability and representativeness due to the variability of policies, resource allocation and provision of mental health services among these countries (Rathod *et al.*, 2017). These shortfalls may lead to an underestimation of the global mental health problem among adolescents (Kapungu et al., 2017). Global estimates for adolescent mental health disorders stand at almost 13% and yet there is a dearth of research on this vulnerable group. For example, in previous South African studies, participants have been recruited from school or clinical settings, resulting in a possible bias (Prince *et al.*, 2007). In light of these shortfalls, this research aims to define the prevalence and possible correlates of self-reported symptoms of depression and generalised anxiety among adolescents between the ages of 14 and 19 in rural Mpumalanga, South Africa.

1.3 Literature review

WHO reports that 1 of every 8 adolescents suffers from a mental health disorder namely: *Emotional disorders* (Anxiety and Depression), *Behavioural disorders* (Attention deficit hyperactivity disorder (ADHD) and Conduct disorder), *Eating disorders* (anorexia nervosa and bulimia nervosa) and *Psychosis* (hallucinations or delusions). The 2 emotional disorders are

classified under the International Classification Diagnosis code as *Depression* (ICD-10) F39 and *Generalised Anxiety*, ICD-10 code F41.1 (ICD-10, 2016). Symptoms of depression include 'persistent sadness and a lack of interest or pleasure in previously rewarding or enjoyable activities' and those of generalised anxiety include 'complaints of tension, somatic pains, agitation, gastric aches and pains however, these two conditions also have some common symptoms such as sudden mood changes and increased heart rates' (World Health Organization, 2017).

1.3.1 The prevalence of Depression

The 2010 Global Burden of Disease study estimated the prevalence of depression to be 6% for individuals aged 5-17 years (Erskine et al., 2018) and was among the 3 top causes of morbidity overall for this age group. Depression is defined as a negative affective state, ranging from unhappiness and discontent to an extreme feeling of sadness, pessimism, and despondency that interferes with daily life' (VandenBos, 2007). Various physical, cognitive, and social changes also tend to co-occur, including altered eating or sleeping habits, lack of energy or motivation, difficulty concentrating or making decisions, and withdrawal from social activities (American Psychological Association, 2015). Of the numerous global depression studies, few have been conducted in Africa and even fewer among African adolescents.

Studies carried out in 4 poor rural districts of North-Eastern Uganda using the Strengths and Difficulties questionnaire (SDQ) and the MINI International Neuropsychiatric Interview for children and adolescents (M.I.N.I.-KID) among 1587 children and adolescents (3-19 years old) reported a point prevalence of depression to be 8.6%. Similar to the current study, this study investigated several correlates of depression namely: living arrangements, highest education attained, socio-economic status determined by among other things household income, house structure and parents' education level (Kinyanda *et al.*, 2013). While a 6 sub-Saharan countries'

study using the Short Moods and feelings Questionnaire (SMFQ) reported a prevalence for depression between 21.1-31.3% among 3 urban sites and 5 rural sites. Food insecurity, poor access to health care, substance use, older age and the female sex were found to be associated with depressive symptoms and suicidal ideation (Nyundo *et al.*, 2019). Varying prevalence rates of depression, in similar rural settings, have also been reported in South Africa with Rocha and colleagues using the Major Depression Section of the Structured Clinical Interview for Depression (SCID) reporting a prevalence of 47% among Hlabisa pregnant women in KwaZulu Natal (Rochat *et al.*, 2013) and Filiatreau and colleagues in a study of adolescents (12-24 years old) using the 20-item Centre for Epidemiological Studies-Depression (CES-D) scale in rural Mpumalanga, the same site where this current study was conducted, and reported a prevalence of 28.1% among adolescents aged 12-24 years living with HIV (Filiatreau *et al.*, 2021).

1.3.2 The prevalence of Generalised Anxiety

Global adolescent prevalence of generalised anxiety estimates are 3.6% (10-14years old) and 4.6% (15-19 years old) and can result in severe morbidity and impaired social and academic performance (World Health Organization, 2017). Generalised anxiety is an emotional state whose symptoms include uneasiness, somatic complaints, the belief that something dangerous will happen and anticipation of bad luck (VandenBos, 2007). Because of such perceptions, the body gets into a flight, fright or fight mode resulting in muscle tension, increased breathing and heart rate. The belief in impending danger and consequently a protracted response is what distinguishes it from normal fear which is a proper immediate and brief response to a recognisable and particular threat (American Psychological Association, 2015).

Kuringe and colleagues, from a cross-sectional study in rural North West Tanzania using the Generalized Anxiety Disorder-2 (GAD-2)for screening, reported a prevalence of 31%, (95%CI: 29.0% - 32.3%) among 15-23 years old out of school adolescent girls and young

women (Kuringe *et al.*, 2019). In this study, age, educational status and family composition were found to be significantly associated with anxiety. While West and colleagues in a cross-sectional study of HIV positive Johannesburg adolescents (9-19 years old) using the 4 self-reporting tools namely: the Children's Depression Inventory–Short, Revised Manifest Anxiety Scale, Child Post-Traumatic Stress Disorder (PTSD) Checklist, and a modified version of the Medical Outcomes Study Social Support Scale, reported a prevalence of 7% (West *et al.*, 2019). They also reported that those with a strong social support were 72% less likely to screen positive for a mental health disorder such as depression, anxiety and post-traumatic stress disorder (PTSD). An increased number of generalised anxiety episodes increase the risk of developing depression, suicidal ideation and substance abuse in adulthood (James et al., 2013). The sufferer may or may not be aware that they worry too much, even when the situation does not warrant worry. In the case of children and adolescents, generalised anxiety can hamper social and academic participation (Bentley et al., 2016).

1.3.3 The Burden of Depression and Anxiety among adolescents

Depression and anxiety are the leading causes of mental health disorders among 10-24-year-olds and negatively impact the economic and educational outcomes and contribute to crime and completed suicide (Ajaero, Nzeadibe and Igboeli, 2018). The complications are vast and include social isolation, relationship and family conflict, school and work difficulties, somatic complaints, panic disorders, social phobias, stigma, suicidal thoughts, completed suicide, violence, substance abuse. A few of these complications will be discussed below, to shed light on the burden that these conditions pose to one's wellbeing and the community at large.

1.3.3.1 Non-fatal suicidal behaviour and completed suicide

Evidence from previous studies suggests that mental health disorders are a strong risk of suicidal thoughts and attempts among sufferers, with depression being the strongest predictor

(Khasakhala *et al.*, 2011). A study from the Netherlands done in 2010 by Gijzen and colleagues found depression to be the main risk factor for completed suicide and reported that completed suicide was the major source of death in youths aged 15-19 years old in that country (Gijzen *et al.*, 2018). Similarly, Bantjes and colleagues reported that among South African university students, those who had prior posttraumatic stress, depression and anxiety reported higher incidences of suicidal ideation compared to the ones who did not (Bantjes *et al.*, 2016). Qin and colleagues highlighted that ensuring treatment and recovery was reported to have a significant reduction in the rates of completed suicide when they reported a higher risk of completed suicide among patients who had shorter hospital treatment compared to those who were admitted longer (Qin and Nordentoft, 2005).

1.3.3.2 Later life depression and anxiety

Adolescence who suffer from anxiety and depression are more prone to developing later major depression, anxiety, suicidal thoughts and early parenthood (Fergusson and Woodward, 2002) and the same was echoed by Gijzen and colleagues who found adolescent depression to be a major correlate for the development of adult depression (Gijzen et al., 2018). Similarly, Thapar and colleagues, in a systematic review of longitudinal studies of adolescent depression reported that once an adolescent suffered a depressive episode, they were more likely to relapse during their adult life (Thapar et al., 2012). The relapse can manifest as one or more of several mental health disorders such as suicidal tendencies, anxiety, substance abuse or bipolar disorder (Thapar et al., 2012).

1.3.3.3 Substance and alcohol abuse

Evidence from several global studies has linked prior common mental health disorders with substance and alcohol abuse (Compton *et al.*, 2007; Kessler *et al.*, 1997; Breslau, Kilbey and Andreski, 1991) as well as from South Africa, where Stein and others found a strong correlation between antenatal depression and drug use (0.111, p=.047) and alcohol use (0.180, p-001) (Stein *et al.*, 2012). Mpanza and colleagues attributed poverty and unemployment in rural South Africa, KwaZulu Natal as playing a role in fostering substance and alcohol abuse where households produce home-brewed beer to supplement their sources of income (Mpanza and Govender, 2017). Substance abuse could also emanate from depression that results from poverty, as reported by Dagher and colleagues where among their study participants that reported the highest rates of depression and consequently substance abuse, they also reported the highest rates of prior childhood poverty (Dagher and Green, 2015).

1.3.3.4 Educational impairment and unemployability

Serious social and educational impairments can also result from depression and anxiety (Lewinsohn et al., 1999) as reported by Bantjies and colleagues (Bantjes *et al.*, 2019). In a study among first-year university students (those 18 years and older), depression was prevalent in 24.7% of students. Anxiety was the second most prevalent common mental disorder with a prevalence of 22.6%. The median age of onset for both depression and anxiety was found to be 15 years, suggesting that many adolescents start to experience depressive symptoms early in life just as they start secondary education. The introduction of a greater workload and new concepts in high school can add additional strain to the already depressed and anxious adolescent (Bantjes *et al.*, 2019).

Later in life people, who suffer from depression and anxiety experience high rates of job dissatisfaction, failure to retain jobs, a decline in job performance and high job turnover

(leaving a job) (Murray and Lopez, 1996). This predicament then affects one's income and consequently their socioeconomic status hence adding to the already existing difficulties of depression and anxiety.

The impending dangers that can result from depression and anxiety warrant priority being given to their prevention, diagnosis and treatment. As such, recognition and treatment of mental health in adolescents and viewing it as a serious health challenge in this age group is of utmost importance.

1.3.4 Correlates of depression and generalised anxiety in adolescents

Several factors - in isolation or combined – can affect an individual's mental health and studies have sought to explain the correlates of depression and anxiety using a biopsychosocial framework of mental health. *Social* (family, upbringing, poverty, peer relations, media, culture, traumas & discrimination), *Biological* (sex, age, genetics, hormones, physical health, alcohol & stressors) and *Psychological* (beliefs, emotions, coping skills, cognition, biases and intellectual abilities) are all believed to, either solely or in combination, impact one's mental health (*The Biopsychosocial Model of Mental Health – Delphis Learning*, 2019).

While the previous list of correlates is quite exhaustive in nature, the current study examines some of the more commonly measured correlates, namely: sex, age, education, socioeconomic status, food insecurity, media and living arrangements.

1.3.4.1 Conceptual framework of the study

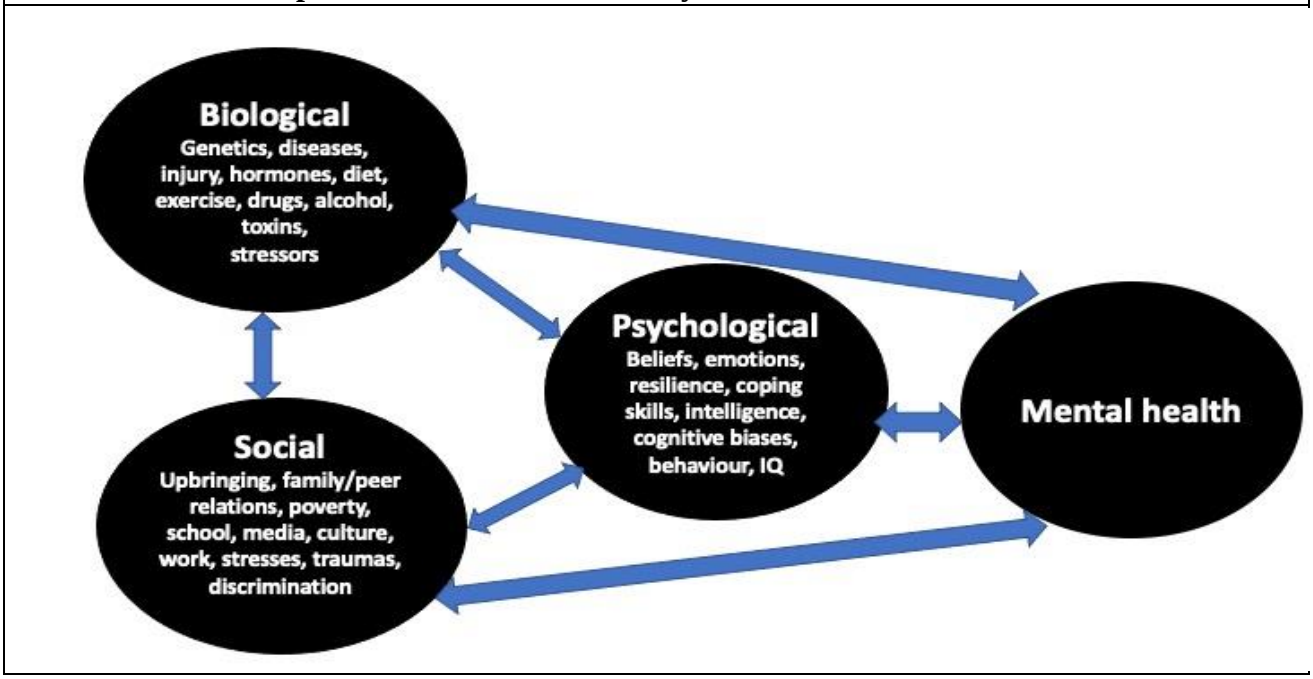

Figure 1. (The Biopsychosocial Model of Mental Health – Adapted from Delphis Learning, 2019)

1.3.4.2 Biological factors

1.3.4.2.1 Sex

There is a marked difference in the prevalence of most mental health disorders when comparing men and women (Riecher-Rössler, 2010), with women experiencing a higher lifetime prevalence than men (Boyd *et al.*, 2015). The World Health Organization reports that globally women are twice more likely to suffer from depression than men and women's biological predisposition gives rise to societal gender norms and consequently gender roles that place vast demands on the girl child. These gender roles impose predetermined roles and responsibilities that can make girls feel like they do not have autonomy on decisions that affect their lives compared to boys of the same age group. Hence, a girl's self-esteem can be affected resulting in feelings of depression and or anxiety. Women are more prone to experience gender-based violence resulting in depression and anxiety whereas men who experience the same trauma are reported to develop anger and high-risk behaviours (Afifi, 2007). On the other hand, the

socialization of boys to not express their emotions also introduces high levels of distress (WHO, 2001).

Women suffer more from mental disorders than men, likely due to risk factors such as socioeconomic disadvantage, gender-based violence, low income and income inequality, low social status and the demands of life as they have responsibilities for the care of others (Vlassoff, 2007). Some responses may be associated with female hormonal changes, making them more vulnerable to harmful effects of stress (Thapar et al., 2012).

Several studies were undertaken globally and in South Africa support the findings that women suffer from depression and anxiety more likely than men. Studies that reported a higher depression prevalence in females than males include Gao and colleagues' findings from fifteen Chinese universities (18-year-old subjects) where female students reported 45% compared to males who reported 40% (Gao, Ping and Liu, 2020). In Northern Santiago, Chile, Marcelo and colleagues reported a higher prevalence among females (19.8%) (average age of participants 15.2 years) than males (13.2%) of sub-threshold depression (characterized by the presence of between 2 and 5 depressive symptoms for a minimum duration of 2 weeks)(Rivas Rodríguez *et al.*, 2012); and a South African rural/urban study by Ajaero and colleagues of adolescents (15-19 years old) reported that urban females had a higher prevalence (10.33%) than urban males (8.44%), as well as rural females (15.6%) compared to their rural male counterparts (14.08%) (Ajaero, Nzeadibe and Igboeli, 2018).

1.3.4.2.2 Age

Age has been associated with the development of depression and anxiety illnesses, especially in older people due to the development of chronic illnesses, marital problems and disruptions, perceived social positions, the likelihood of job loss due to retirement, being an immigrant and financial strain (Mundt *et al.*, 2014). Studies investigating the correlates of depression and

anxiety among adolescents, and reporting age as one of them, have attempted to explain the association. Ajaero and colleagues reported that among an urban/rural adolescent population (15-19 years) in South Africa, an increase in age increased the odds of suffering from depression OR 1.176, p=0.05, attributing the relationship to adolescents' seemingly increased responsibilities both at home and at school. These burdens may result in academic failure and consequently depression (Ajaero, Nzeadibe and Igboeli, 2018). Similarly, Saluja and colleagues reported an increase in depression as age increased among students 11-15 years old in United States schools, finding that the oldest children had the highest prevalence: 24.5%, (95%CI: 20.7-28.3%) (Saluja *et al.*, 2004). Nyundo and colleagues in a six-country sub-Saharan study, attributed the relationship between older age and depression and anxiety to biological and social changes as adolescents got older, citing specific changes in oestradiol levels in girls as an explanation for some of the higher levels of depression seen in girl adolescents (Nyundo *et al.*, 2019).

1.3.4.3 Social factors

1.3.4.3.1 Educational level at the time of this study

Das and colleagues stated that higher educational attainment is positively associated with better mental health (Das *et al.*, 2007). However, several studies have found the opposite. Ajaero and colleagues in a study of the mental health status of immigrants in South Africa, reported the contrary, finding those with higher educational attainment had higher odds of having a mental health issue compared to those with lower attainment (OR = 1.749, p <0.001 compared to OR = 1.683, p <0.0001, respectively) (Ajaero, Odimegwu and Chisumpa, 2017). Similarly, Mungai and Bayat using data from the South African National Income Dynamics Study, reported that having higher educational attainment increased the odds of depression (Mungai and Bayat, 2019). These findings were echoed in a study by Onuh and colleagues across South Africa

where they reported a correlation between higher educational attainment and depression and anxiety (Onuh *et al.*, 2021).

1.3.4.3.2 Socioeconomic and food security status

This present study investigates two of the socioeconomic factors in the conceptual framework namely, *Food Insecurity* and *Socioeconomic* status. Between 720-811 million people globally are food insecure. *Food security* is defined as being present when everyone, always has access to adequate, safe and nourishing food to meet the dietary requirements for a healthy life (The State of Food Security and Nutrition in the World 2021, 2021). One's *socioeconomic* status (SES) and *Food Security* (FS) go beyond affecting physical health. A study carried out by Jones showed that food insecurity is one of the highest risk factors for poor mental health, and specifically psychological stressors globally (Jones, 2017). The lower the socioeconomic status, the more difficult it is for families to ensure food security. The World Bank reported that in most African countries, children suffer from the consequences of poverty and food security more than adults (Batana et al., 2013). Thus, food insecurity is likely to be an important correlate in rural South African adolescents and will be investigated as one of the indicators of poor mental health. Jones analysed the relationship between food insecurity and mental health in 149 countries (mean age of participants=42) and reported a dose-dependent relationship between food insecurity and poor mental health, with those having the most severe food insecurity reporting a poor mental health prevalence of 24.5%, (95%CI: 22.7-26.3%) in comparison with those that had enough food who reported a poor mental health prevalence of 10.4%, (95%CI: 9.5-11.2%) (Jones, 2017). The pattern was reported to be consistent globally, implying the existence of this association across cultures. The same study reported a lower magnitude of association between socioeconomic status and poor mental health (Jones, 2017). Similarly, Hatcher and colleagues found that 39.2% of peri-urban South African young men

(18-30 years) who reported low levels of childhood income and low food security had symptoms consistent with depression (Hatcher *et al.*, 2019).

1.3.4.3.3 Home living arrangements

Another social factor that this study investigates is one's access to media although social factors that likely impact one's mental health are not limited to media, but also include immigration status, community culture, access to healthcare, peer and familial relationships (George *et al.*, 2015). This present study investigates familial relationships in the form of an individual's living arrangements and their association with depression and anxiety symptoms. In a bid to investigate the social correlates and prevalence of anxiety among adolescents (mean age 12.96 years in China), Guo and colleagues conducted a longitudinal study and found family dysfunction to be one of the major risk factors among those who suffered from anxiety (Guo et al., 2018). Kinyanda and colleagues reported that negative relationships between participants and their principal caregivers, domestic violence and unfavourable living arrangements were also significantly associated with depression and anxiety in adolescents (Kinyanda et al., 2013). The importance of positive family relations was also emphasized by the findings of a Western Cape study on family structure and functioning among South African adolescents (mean age of participants 16.31 years) which reported that a household with 2 parents fostered higher satisfaction of psychological needs than a single parent household (Davids *et al.*, 2016). Family structure and function play a crucial role in helping to solve problems, provide warmth, behaviour control and communication (Berge *et al.*, 2013), and were also reported to have a positive influence on adolescents' uptake of physical activities, good diet and less sedentary behaviour thus promoting better physical and mental health.

1.4 Justification

Limited research from rural South Africa has focused on the prevalence and correlates of self-reported symptoms of depression and generalised anxiety among adolescents. Gaining an in-depth understanding of the burden and factors that contribute to depression and anxiety and its correlates will help inform policymakers to develop interventions that may reduce the prevalence of these conditions among adolescents (Reddy, 2016).

This study aims to determine the prevalence of depressive and anxiety symptoms, using standardized tools, among male and female adolescents (14-19 years old) in rural Mpumalanga, South Africa. Furthermore, this study will investigate individual correlates, including socio-demographic and socioeconomic factors, of depression and generalised anxiety among these adolescents. In doing so, the research aims to bring forth a greater understanding of the burden and correlates of depression and anxiety among rural South African adolescents to inform policymakers in the development of interventions tailormade to reduce the risks of depression and anxiety among this vulnerable group. By highlighting the possible biopsychosocial factors that specifically are associated with mental health within the population under study, the public health policy makers will be more equipped in detecting trends and social predictors of mental health thereby ensuring timely interventions and remedies.

1.5 Research Question

What are the prevalence and social and biological correlates of self-reported symptoms of depression and anxiety among rural adolescents, aged 14 to 19 years, in South Africa?

1.6 Study Objectives

1.6.1 Main Aim

The main aim of this study is to measure the prevalence and examine correlates of self-reported symptoms of depression and anxiety among adolescent males and females, aged 14-19 years, in the rural Bushbuckridge subdistrict, Mpumalanga Province, South Africa in 2018 to inform policymakers to assist with the development of interventions to reduce risk of depression and anxiety in this vulnerable age group.

1.6.2 Specific objectives

The specific objectives are to:

- Estimate the prevalence of self-reported symptoms of depression and anxiety among adolescent males and females, 14-19 years in rural Mpumalanga South Africa in 2018.
- Investigate the correlates of depression and anxiety among adolescent males and females, 14-19 years in rural Mpumalanga, South Africa in 201

1.7 Chapter summary

This chapter included the background and problem statement. The research aims and objectives as well as the justification of the study were outlined. Literature on correlates of mental health namely, social and biological correlates of depression and anxiety was presented highlighting previous research in the field of adolescent mental health.

CHAPTER 2 METHODOLOGY

2.1 Introduction

This chapter seeks to describe and clarify the process of data collection, the data sources, the study hypothesis and criteria for the participant inclusion. Furthermore, this chapter includes a description of the data analysis plan.

2.2 Study site

The MRC/Wits-Agincourt Health and socio-Demographic Surveillance System (HDSS) is located in the Bushbuckridge sub-district, Mpumalanga Province, north-eastern South Africa. The Agincourt HDSS is located 500km northeast of Johannesburg, near the Mozambican border and was established in 1992 to support the district health systems development. The HDSS has a population of about 120 000 Xitsonga-speaking people in 31 contiguous villages, runs routine updates of residence status (out-migration and in-migration, deaths, and births) and undertakes an annual census where household and individual information (asset status, food security status maternity history, individual grants, education status, individual health module, and child health vaccination information) is collected (Kahn *et al.*, 2012).

2.3 Study design

2.3.1 Primary study

Ntshembo (“Hope”) study, was a cross-sectional pilot study, nested within the Agincourt HDSS, that sought to measure the changing prevalence of overweight and obesity in adolescents aged 12-19 years, describe their understanding of overweight and obesity, and determine the feasibility, acceptability and experience of a complex intervention to foster behaviour change for healthier lifestyles in rural Mpumalanga in 2018.

2.3.2 Primary study population

The study participants were selected from 2 conveniently selected villages on the border of the HDSS out of the 31 villages for purposes of the cross-sectional Ntshembo pilot study. The two villages share a high school and purposive sampling was done by selecting all households with adolescents aged between 12-19 years in the 2017 census residing in the two selected villages. Adolescents who were not able to participate or provide consent/assent had an intellectual disability or those who had already matriculated were excluded from the study.

All adolescents living in these two villages, 715 adolescents were identified and invited to participate; out of these 205 (28.7%) could not be found and were assumed to have migrated. Thus, a total of 510 (71.3%) participants were screened for inclusion in the study. Of these, 35 (6.9%%) were excluded as they had withdrawn from school and 43 (9.1%) refused to participate. 432 (91%) participants then took part in the primary study Ntshembo, 188 (43.5%) did not complete both the Generalised Anxiety Disorder (GAD-7) for anxiety (*Appendix 5-GAD708.19.08*) and the Patient Health Questionnaire (PHQ—9) for Depression and associated symptoms (*Appendix 4-tool_phq 9),* 244 (56.5%) participants completed both the data collection tools for this study and were included for analysis.

2.3.3 Data collection approach

Using information from the 2017 Agincourt HDSS population update, households with adolescents were visited by trained fieldworkers who invited adolescents and their caregivers to participate in the Ntshembo study. The Ntshembo study data collection occurred between 27 September and 7 December 2018.

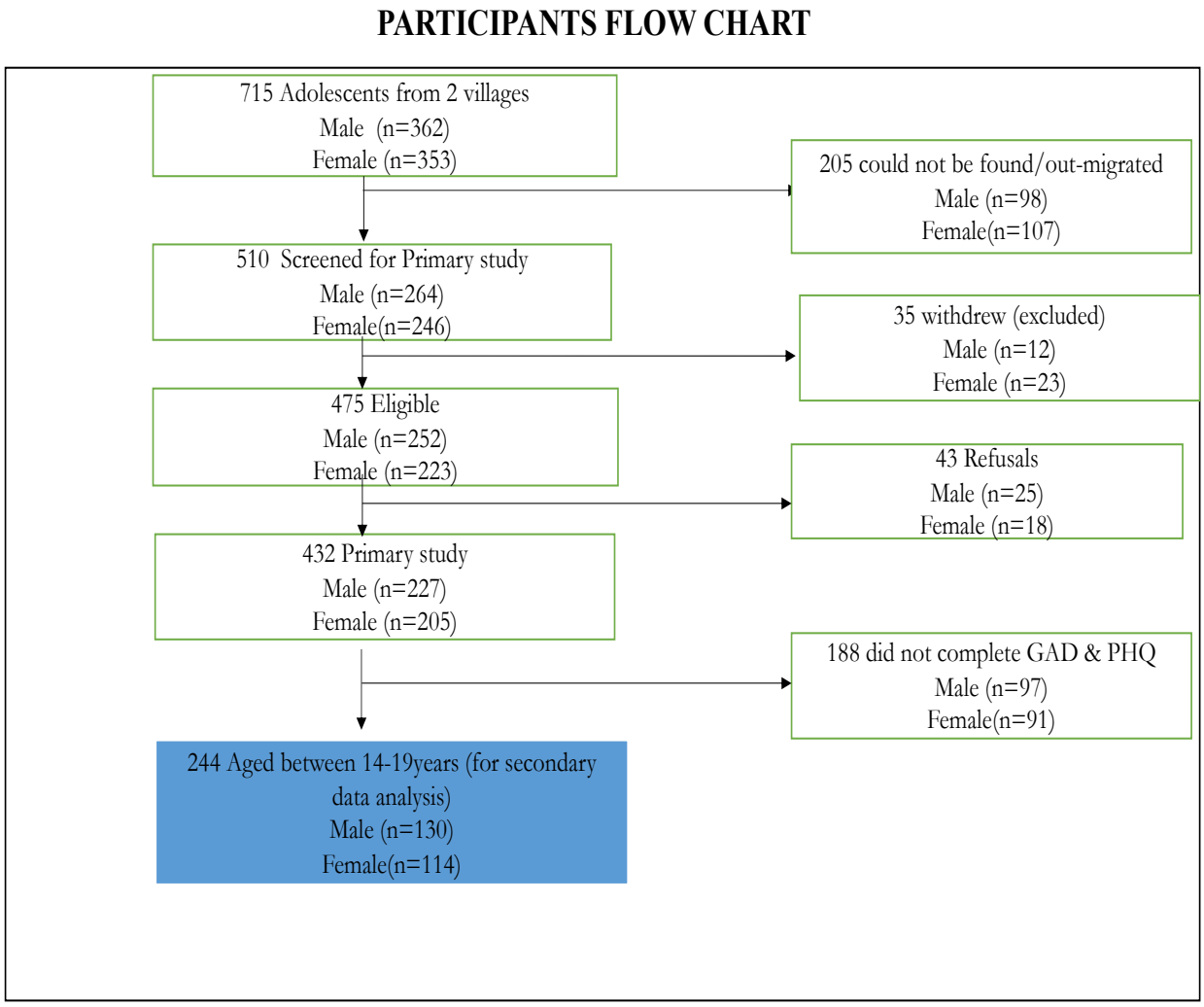

Figure 2. Flow chart of participants in Ntshembo study, Agincourt 2018

2.4 Secondary analysis

The current study was a cross sectional secondary data analysis of the Ntshembo pilot study and the variables used in this secondary data analysis form part of the data collected during the Ntshembo study.

2.4.1 Sample size calculation for secondary analysis

Assuming a prevalence of depression and anxiety of 14.1% from previous Agincourt studies (Cortina *et al.*, 2013), with a primary study sample of 432 participants in and accepting a margin of error of 5% and a confidence interval of 95%, we would need a sample of 204

participants for this secondary data analysis to allow for a margin error of 5%. With 244 participants (from a population of 432), the margin of error was reduced to 3%. That said, no *a priori* calculation of sample size was undertaken as all adolescents in both villages selected for the Ntshembo pilot study were invited to take part.

2.4.2 Data collection tools for exposure variables

2.4.2.1 Socioeconomic status (SES)

Socioeconomic status information was collected during the 2017 Agincourt census update by administering the Agincourt Household Asset Status form (Agin HHAST) (*Appendix 6*). This tool contains a list of assets against which each household in the HDSS confirms availability, functionality and quantities. The SES is presented as ascending quintiles from first to fifth (Kabudula, Houle, Collinson, Kahn, Gómez-Olivé, *et al.*, 2017). The variables used to construct the composite included: construction materials in the main dwelling; type of toilet facilities and sources of water; sources of energy; ownership of modern assets and livestock.

2.4.2.2 Food security status

To determine the food security composite score, field workers administered the Food Security Status form (*Appendix 7*-AGN-FDSCY). The food security form is not collected every year in the Agincourt HDSS. In 2018, the year of the Ntshembo pilot study, the food security module was not administered. We thus used data from the most recent (2016) food security module, collected two years before this study. The questions asked in the module that were used to create the composite score can be found in *Table 1*. These questions were then weighted using principal component analysis (Wold, Esbensen and Geladi, 1987) to come up with the composite score. The scores were then categorised into households with low food security, moderate food security and high food security.

Table 1: Food security questions used to create composite scores

The attribute of food security	Description of questions
Sustainability	How regularly does your household eat the following? Maize, Rice, potatoes, chicken, fish, eggs, vegetables, fruit, wild herb and bread
Access and entitlement	How many meals does your household normally take in a day? Maximum number of meals for adult males, females and children?
Continuity	How do you expect the amount of food available to your household to change in the coming year?
Security	How do you supplement your food requirements? Food aid from the government, borrow money to buy food, buy food from the market, relatives, family or friends bring food, gather wild fruits from the bush, gather food from the bush, sell household goods to buy food and (or) sell livestock to buy food?

2.4.2.3 Demographic information of study participants

As part of the Agincourt HDSS, the participants' demographic information is collected and updated annually by trained field workers (AGN-CNSSB) *(Appendix 5).* The demographic information that this study utilised was the *Sex* of the participant (presented as binary male or female), *Age*, as a continuous variable (14-19 years) and highest education grade passed at the time of study categorised as *Grade 0-5, Grade 6-8 and Grade 9 and above.*

2.4.3 Data tools for Secondary analysis outcome variables

2.4.3.1 Patient Health Questionnaire

The Patient Health Questionnaire (PHQ) is a self-administered version of the PRIME-MD diagnostic instrument for common mental disorders, that uses a 2 week recall data collection of depressive symptoms. For this study, the PHQ-9 was both forward and backwards translated into Xitsonga from English and vice versa by fieldworkers who were fluent in both English and Xitsonga. The PHQ-9 is a depression module that contains nine questions, relating to one's level of interest in doing things, sleep patterns, energy level, appetite or overeating habits,

feelings of failure, restlessness, concentration levels, speaking difficulties, thoughts of committing suicide and how the above would have affected the respondent's daily carrying out of work or duties, by the level of difficulty (*Appendix* 2). The tool scores each of the 9 DSM-IV criteria as "0" (not at all) to "3" (nearly every day).

The score for self-reported symptoms of depression using the PHQ—9 is categorised by level of severity as:

- 0-4*: Minimal depression*
- 5-9: *Mild depression*
- 10-14: *Moderate depression;*
- 15-19: *Moderately severe depression*; and,
- 20-27: *Severe depression*(Udedi, 2014).

However, in this study and as done previously in other works (Dow *et al.*, 2016), self-reported symptoms of depression will be classified as a binary outcome: Absence of (0-10) and Presence of (above 10). The PHQ-9 was chosen to evaluate depressive symptomology as it has been used before in similar rural African settings (Cholera *et al.*, 2014; Thapar *et al.*, 2012) and has proved to be a reliable tool for evaluating adolescents' depressive symptoms (Borus *et al.*, 2020; Dow *et al.*, 2016). In one of the first validation study of the PHQ-9, by Cholera and collegues in Johannesburg, South Africa the sensitivity was found to be 78.7% (95% CI: 64.3-89.3) and a specificity of 83.4% (95% CI:79.1-87.2) and the PHQ-9 proved a fairly accurate tool for screening depression symptoms. It also proved to be easy to administer for lay health care workers (Cholera *et al.*, 2014). Agwarral and collegues in a study to evaluate the PHQ-9, among Johannesburg adolescents reported internal consistency and face validity and recommended that this tool is appropriate for use in settings with low or minimal mental health knowledge (Aggarwal *et al.*, 2017). Having the PHQ-9 administered in Xitsonga in the current

study also ensured better understanding of questions by both field workers and study participants.

2.4.3.2 Generalised Anxiety Disorder 7-item (GAD-7) scale

Generalised anxiety was the second major outcome of interest. Again, for purposes of this study, the GAD-7 was forward and back-translated and a panel consensus was reached by individuals who were fluent in both English and Xitsonga. The Generalised Anxiety Disorder (GAD-7) questionnaire is a 7-item, self-reported symptoms of anxiety questionnaire designed to assess the respondent's level of generalised anxiety over the previous two weeks. The questions seek to establish the extent to which the feelings of nervousness, uncontrolled and excessive worrying, irritability and restlessness impact the respondent. The GAD further asks the level of difficulty by which the feelings have made carrying out the respondent's daily routines. The GAD-7 is believed to be a suitable tool which can be administered in adolescents to provide a reflection of anxiety symptoms (Mossman *et al.*, 2017) and in a study to examine the its psychometric properties in a study among adolescents in Ghana was found to have consistency and reflected significantly with measures of anxiety, suicidal tendencies and mental well-being, which proved construct validity (Adorjolo et al 2019). The scores for self-reported symptoms of anxiety using the GAD-7 are categorized by level of severity as:

- *0–4: Minimal anxiety;*
- *5–9: Mild anxiety;*
- *10–14: Moderate anxiety; and,*
- *15–21: Severe anxiety*, (Dam and Earleywine, 2011).

Also as done in other work, generalised anxiety will be presented as a binary outcome: Absence (0-8) or Presence (9 and above) of anxiety (Spitzer *et al.*, 2006; Dow *et al.*, 2016).

2.5 Data handling

Data was captured using REDcap (Harris *et al.*, 2009) and then uploaded onto the MRC/Wits-Agincourt server, located in the Agincourt data centre, for storage where it is securely stored in the data centre with strict access protocols. Data is backed up regularly.

Just over 40% (n=169) of participants of the total study participants (n=413) did not have responses for the PHQ-9 and GAD-7 questions. A sensitivity analysis was done to check if there was data missing at random and the results are shown in *Table 2* below. For this study all participants with missing responses for PHQ-9 and GAD-7 were removed from the analysis.

Table 2: Socio-demographic information for of population who completed the GAD=7 and PHQ-9 (participants with missing information were excluded from the analysis)

	Completed (n=244)	Missing (n=169)	p.value
Sex	.		
Females	114 (46.7%)	79 (46.8%)	
Males	130 (53.3%)	90 (53.25%)	0.99
Educational level			
Grade 1-5	62 (25.4%)	17 (10.1%)	
Grade 6-8	119 (48.8%)	92 (54.4%)	
Grade 9 & above	61 (25%)	57 (33.7%)	
Unknown	2 (0.8%)	3 (1.8%)	0.001
Age in years			
14-15	84 (34.4%)	53 (31.4%)	
16-17	74 (30.3%)	57 (33.7%)	
18-19	86 (35.3%)	59 (34.9%)	0.72

2.6 Statistical analysis plan

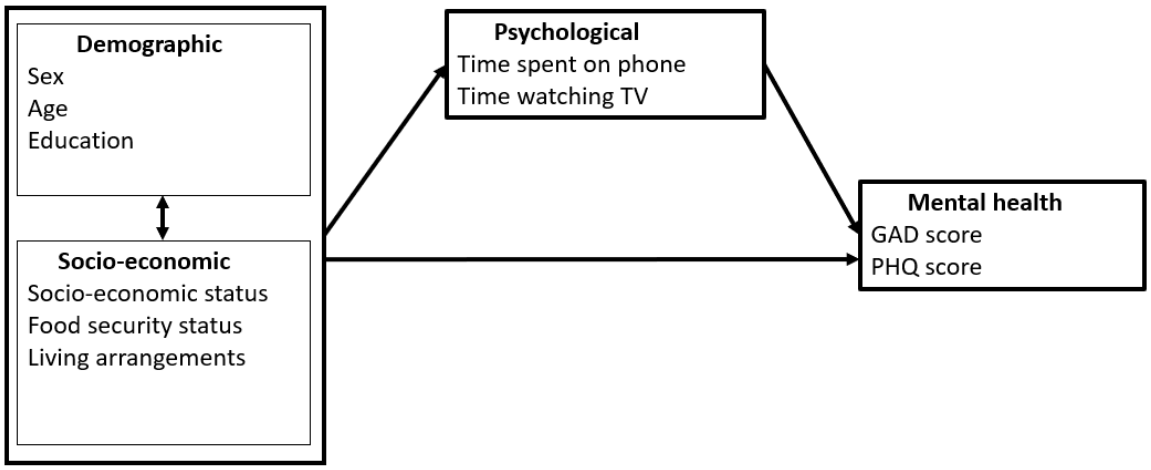

Figure 3. Contextual variables from the study and their perceived relationship to mental health outcomes

The present analysis was carried out using Stata version 15. Descriptive statistics of the study population were used to describe socio-demographic factors namely: age, sex, educational level, residence, socioeconomic status (SES) and food security. Prevalence was reported by age and sex, with 95% confidence intervals (95%CI). Chi-square tests of association were performed under the hypothesis that there was no significant association between the predictor variables and the prevalence of depression and anxiety in the adolescent population. The demographic, socioeconomic and food security factors that were considered potential predictors for depression as identified in the literature and available in the data collected in the pilot study were tested individually. Multivariate logistic regression analyses were performed to assess the impact of sex, education level attained at the time of the study, food security and SES on depression and generalised anxiety. A separate model with anxiety as the outcome was also be developed. Variables that had a p-value ≤0.25 in the univariate analysis were included in a backward stepwise logistic regression. Results from the regression models were presented as odds ratios and 95%CI. P-values were based on two-sided t-tests, where the level of

statistical significance was set at p=0.05. Odds ratios were used in this study because literature suggests that when "the outcome is rare (<10%), the value of OR is not too different from that of RR, and the two can be used interchangeably irrespective of whether the risk is lower or higher in the exposed or non-exposed' and the risk ratio would be approximately the same as the odds ratio and in this study self-reported depressive symptoms and anxiety symptoms were not common among the participants which justifies our use for odds ratios (Ranganathan, Aggarwal and Pramesh, 2015)

2.7 Ethical consideration

Ethical clearance was obtained from the Human Research Ethics Committee (HREC) of the University of the Witwatersrand (Clearance Certificate number M1711103), and the Mpumalanga Provincial Health Department Research Ethics Committee (Approval Ref. Number MP_201804-007). Permission from village leadership was obtained through established processes led by the Public Engagement Office of the MRC/Wits-Agincourt Research Unit. Written informed consent was sought from participants over 18 years of age, and assent from younger adolescents after receiving consent from their caregivers/parents. Confidentiality and anonymity of participants' identifying information, was ensured by making sure that information was only accessible to members of the research team and consent forms were securely stored in locked filing cabinets inside a locked room at the Agincourt HDSS offices. Standard operating procedures already exist within the HDSS for handling any distress that may arise from the study for both field workers and participants. Psychological distress due to participating in the studies were recognized and reported using the Psychological Distress Standard Operating Procedure document. Briefly, those participants who were found to have high levels of self-reported symptoms of depression or anxiety were referred to the

local primary health care facility or local counselling services for further investigations, depending on severity.

2.8 Chapter summary

This chapter included a description of the study population and sampling, the data collection approach and the tools used, a description of the predictor and outcome variables and an overview of the data analysis plan**.** The next chapter will present the results of the study.

CHAPTER 3 DATA ANALYSIS AND RESULTS

3.1 Introduction

This chapter presents the results that address the objectives of this study. Specifically, the goal of this analysis is to define the prevalence of depression and anxiety symptoms among rural South African adolescents and examine potential correlates of depression and anxiety. The correlates of interest include demographic factors, namely sex, age, educational level, socioeconomic status and food security (*Table 5*) below.

3.2 Descriptive Analysis

3.2.1 Patient health questionnaire results

Table 3, presents the results of depressive symptom severity based on the PHQ-9. Presentation of PHQ-9 by severity was also done in Australia by Titov and collegues when they carried a prospective non-controlled cohort study to assess the feasibility of online behavioural therapy (Titov *et al.*, 2015). Of the 244 participants who completed the PHQ-9, 146 (59.8%) reported having *Minimal* symptoms of depression, 71 (29.1%) self-reported M*ild* depression, 25 (10.3%) *Moderate depression* and 2 (0.8%) presented with *Moderately severe* depression. None of the participants reported *Severe* depression. This presentation merely provides the distribution of depressive symptoms among participants using for the PHQ-9 (Kroenke, Spitzer and Williams, 2001).

Table 3: Prevalence of symptoms of self-reported depression severity by sex

Depressive symptom by severity	Males (n=130)	Females (n=114)	Total (n=244)
Minimal depression (0-4)	82 (63.1%)	64 (56.1%)	146 (59.8%)
Mild depression (5-9)	36 (27.8%)	35 (30.7%)	71 (29.1%)
Moderate depression (10-14)	11 (8.5%)	14 (12.3%)	25 (10.3%)
Moderately severe depression (15-19)	1 (0.8%)	1 (0.9%)	2 (0.8%)
Severe depression (>19)	0 (0%)	0 (0%)	0 (0%)

3.2.2 Prevalence of Self-reported symptoms of anxiety by severity

Spitzer et al in a brief measure for assessing generalised anxiety disorder using the GAD-7 presented the results by severity as shown for this study below in *Table 4* (Spitzer *et al.*, 2006). GAD-7 is interpreted as follows: 0–4= *Minimal* anxiety; 5–9= *Mild* anxiety; 10–14= *Moderate* anxiety; and 15–21= *Severe* anxiety. Of those participants who completed the GAD-7 (n=244), 190 (77.9%) presented as having *Minimal* anxiety, 43 (17.6%) *Mild* anxiety, 9 (3.7%) *Moderate anxiety* and 2 (0.8%) *Severe* anxiety. The prevalence of self-reported symptoms of anxiety by severity showed no statistical significance by sex (p=0.35)

Table 4: Prevalence of symptoms of self-reported anxiety severity by sex

GAD severity	Males (n=130)	Females (n=114)	Total (n=244)
Minimal-anxiety (0-4)	105 (80.8%)	85 (74.6%)	190 (77.9%)
Mild anxiety (5-9)	19 (14.6%)	24 (21.1%)	43 (17.6%)
Moderate anxiety (10-14)	5 (3.8%)	4 (3.5%)	9 (3.7%)
Severe anxiety (15-21)	1 (0.8%)	1 (0.7%)	2 (0.8%)

3.2.3 Bivariate Analysis

As discussed in the '*Methods'* section, for purposes of this analysis, self-reported symptoms of depression was reported as a binary outcome, defined as having or not having self-reported symptoms of depression (PHQ-9 score: 0-10) and having self-reported symptoms of depression (PHQ-9 score ≥10); a cut off that has been used previously (Spitzer *et al.*, 2006) as mentioned in the *'Methods'* section above. The overall prevalence of self-reported symptoms of depression (PHQ-9 ≥10) among participants was found to be 11.1% (95% CI: 7%-15%) with females reporting a prevalence (13.2%; 95%CI: 6.8-19.4%) and males (9.2%; 95%CI: 4.2-14.3), (p=0.33) (*Table 5).*

GAD-7 scores are presented as a binary outcome as has been done in previous work (Spitzer *et al.*, 2006) (*Table* 5); that is absence of anxiety (GAD-7 score: 0-8) or presence of anxiety (GAD-7 score: ≥9).

The overall prevalence of self-reported symptoms of anxiety (*Table 5*) is 5.3% (95%CI: 2.5-8.2%), with the prevalence in males being almost one and half times that of females (6.2% vs 4.4%, respectively). Despite this difference, the test of association showed that there was no statistically significant difference between the sexes (p=0.89).

Table 5: Descriptive statistics for correlates of self-reported depression symptoms and of self-reported anxiety symptoms

	Self-reported depressive symptoms (n=27)	No Self-reported depressive symptoms (n=216)	p-value	Self-reported anxiety symptoms (n=13)	No Self-reported anxiety symptoms (n=231)	p-value
Sex			0.329			0.54
Males	12 (9.2%)	118 (90.8%)		8 (6.2%)	122 (93.9%)	
Females	15 (13.2%)	96 (86.8%)		5 (4.4%)	109 (95.6%)	
Age (in years)			0.551			0.314
14-15	11 (13.1%)	73 (86.9%)		7 (8.3%)	77 (91.7%)	
16-17	9 (12.2%)	65 (86.8%)		3 (4.1%)	71 (96.0%)	
18-19	7 (8.1%)	79 (91.9%)		3 (3.5%)	83 (96.5%)	
Education level at this time of the study (in grades)			0.435			0.355
Grade 1-5	10 (16.1%)	52 (83.9%)		6 (9.7%)	56 (90.3%)	
Grade 6-8	10 (8.4%)	109 (91.6%)		5 (4.2%)	114 (95.8%)	
Grade 9 & above	7 (11.5%)	54 (88.5%)		2 (3.3%)	59 (96.7%)	
Living arrangements			0.331			0.728
Staying with both parents	13 (12.6%)	90 (87.4%)		5 (4.9%)	99 (96.1%)	
Staying with a single parent	12 (12.4%)	85 (87.6%)		5 (5.2%)	92 (94.8%)	
Not staying with parents	2 (4.7%)	41 (95.4%)		3 (7%)	40 (93.0%)	
Socioeconomic quintile			0.711			0.979
Poorest	6 (13.6%)	38 (86.4%)		2 (4.5%)	42 (95.5%)	
Poor	16 (10.8%)	17 (85.0%)		9 (6.1%)	19 (95.0%)	
Middle	3 (16.7%)	15 (83.3%)		1 (5.6%)	17 (94.4%)	
Wealthy	2 (7.4%)	25 (92.6%)		1 (3.7%)	26 (96.3%)	
Wealthiest	0 (0)	7 (100.0%)		0 (0.0%)	7 (100.0%)	
Food security status			0.701			0.189
Low	2 (9.5%)	19 (90.5%)		3 (14.3%)	18 (85.7%)	
Medium	3 (6.1%)	34 (91.9%)		2 (5.4%)	35 (94.6%)	
High	22 (12.6%)	152 (87.4%)		8 (4.6%)	166 (94.4%)	
Time spent watching TV per week (in hours)			0.595			0.408
1-2hours	8 (8.9%)	82 (91.1%)		4 (4.5%)	83 (92.2%)	
3-4hours	22 (13.6%)	76 (86.4%)		8 (7.9%)	85 (96.6%)	
More than 4	7 (10.6%)	59 (89.4%)		1 (1.9%)	63 (95.5%)	
Time spent on phone per week (in hours)			0.742			0.251
1-2 hours	9 (10.1%)	80 (89.1%)		7 (7.8%)	85 (95.5%)	
3-4 hours	13 (12.9%)	88 (87.1%)		3 (3.4%)	93 (92.1%)	
More than 4 hours	5 (9.3%)	49 (90.7%)		3 (4.6%)	53 (98.2%)	0.72

3.2.4 Logistic regression for self-reported symptoms of depression and the predictor variables

To investigate *a priori* associations between the correlates of interest and self-reported symptoms of depression, univariate logistic regression analysis was performed with the null hypothesis being that no significant relationship existed between self-reported symptoms of depression and the specific correlate of interest.

The univariate logistic regression results are presented in *Table 6* below. The univariate regression showed no statistically significant associations between the correlates of interest and the outcome. At 95% confidence interval, sex, age, education level, living arrangements, SES, food security, time spent watching television per week and time spent on the phone a week showed no significant association with self-reported symptoms of depression as all the p-values within each category were greater than 0.05 (*Table 6*).

Table 6: Logistics regression between predictors variables and self-reported symptoms of depression

	Univariate Odds Ratio [95%CI]	Multivariate Odds Ratio [95%CI]
Sex		
Males	-	-
Females	0.67 [0.30-1.50]	-
Age (in years)		
14-15	-	-
16-17	0.92 [0.36-2.36]	-
18-19	0.59 [0.22-1.59]	-
Education level at this time of the study (in grades)		
Grade 1-5	-	-
Grade 6-8	0.48 [0.19-1.22]	0.43 [0.17-1.12]
Grade 9 & above	0.67 [0.24-1.90]	0.61 [0.21-1.74]
Living arrangements		
Staying with both parents	-	-
Staying with a single parent	0.98 [0.42-2.26]	0.93 [0.40-2.12]
Not staying with parents	0.34 [0.07-1.57]	0.32 [0.14-2.51]
Socioeconomic quintile		
Poorest	-	-
Poor	0.77 [0.28-5.73]	-
Middle	1.27 [0.29-5.73]	-
Wealthy	0.51 [0.09-2.71]	-
Wealthiest	.	.
Food security status		
Low	-	-
Medium	0.62 [0.10-4.01]	-
High	1.38 [0.30-6.31]	-
Time spent watching TV per week (in hours)		
1-2hours	-	-
3-4hours	1.62 [0.63-4.17]	-
More than 4	1.22 [0.05-3.54]	-
Time spent on phone per week (in hours)		
1-2 hours	-	-
3-4 hours	1.31 [0.53-3.24]	-
More than 4 hours	0.91 [0.29-2.87]	-

NB: All of the odds had a p-value >0.05, CI represents the confidence interval

Table 6, above presents the results of multivariate logistic regression for self-reported symptoms of depression controlling for the correlate variables with a p-value <0.25 in the bivariate analysis. These variables were educational level at the time of study and living arrangements. When placed in a multivariate regression, they were not found to be statistically significant (p>0.05).

3.2.5 Logistic regression for self-reported symptoms of anxiety and the predictor variables

A univariate logistic regression was carried out to investigate whether there was a relationship between self-reported symptoms of anxiety and the correlates of interest. The null hypothesis was that no significant relationship existed between self-reported symptoms of anxiety and the specific correlates of interest. Sex, age, education level, living arrangements, socio-economic status, food security, time spent watching television per week and time spent on the phone a week showed no significant association with self-reported symptoms of anxiety as all the p-values within each category were more than 0.05 (*Table 7*).

Table 7: Logistic regression between predictor variables and self-reported symptoms of anxiety

	Univariate Odds ratio [95%CI]	Multivariate Odds ratio [95%CI]
Sex		
Males	-	
Females	1.43 [0.45-4.50]	
Age in years		
14-15	-	
16-17	0.47 [0.12-1.87]	0.58 [0.12-2.73]
18-19	0.40 [0.10-1.60]	0.51 [0.10-2.61]
Education level at the time of this study		
Grade 1-5	-	-
Grade 6-8	0.41 [0.12-1.40]	0.57 [0.15-2.14]
Grade 9 & above	0.32 [0.06-1.63]	0.64 [0.09-4.75]
Living arrangements		
Staying with both parents	1.35 [0.35-5.26]	
Staying with a single parent	1.86 [0.40-8.67]	
Not staying with parents	-	
Socioeconomic status		
Poorest	-	
Poor	1.36 [0.28-6.54]	
Middle	1.24 [0.10-14.54]	
Wealthy	0.81 [0.07-9.36]	
Wealthier	1	
Food security status		
Low	-	
Medium	0.26 [0.04-1.66]	0.36 [0.05-2.44]
High	0.29 [0.70-1.19]	0.42 [0.10-1.86]
Time spent on phone per week in hours		
1-2 hours	-	
3-4 hours	1.83 [0.53-6.30]	
Above 4 hours	0.40 [0.04-3.68]	
Time spent watching TV per week in hours		
1-2 hours	-	
3-4 hours	0.42 [0.10-1.67]	0.50 [0.12-2.14]
Above 4 hours	0.56 [0.14-2.27]	0.62 [0.14-2.64]

NB: All of the odds had a p-value >0.05, CI represents the confidence interval

Those variables that had a p-value of <0.25 in the multivariate analysis above (*Table 7)* were included in a multivariate regression model. The model did not find any significant associations: food security status (p=0.09), time spent watching TV per week (p=0.22), educational level (p=0.15) and age (p=0.19). All the above-mentioned variables had no statistically significant relationship with self-reported symptoms of anxiety, as all the p-values were >0.05.

3.2.6 Association between self-reported symptoms of anxiety and self-reported symptoms of depression

A chi-test of association to investigate if there was an association between the two outcome variables (depression symptoms and anxiety symptoms) was run under the null hypothesis that there is no association. The results are presented below *(Table 8)* below. Out of the 27 participants who reported self-reported symptoms of depression and self-reported symptoms of anxiety, 8 (29.6%) were found to have both; this association was found to be statistically significant (p<0.001).

Table 8: Association between self-reported symptoms of anxiety and self-reported symptoms of depression

	No Self-reported depressive symptoms (n=217)	Self-reported depressive symptoms (n=27)	p-value
Self-reported symptoms of anxiety			
No self-reported symptoms of anxiety	212 (86.9%)	19 (7.8%)	
Presence of self-reported symptoms of anxiety	5 (2.5%)	8 (3.3%)	<0.001

3.3 Chapter Summary

This chapter aimed to present the results of the study, the sample demographics, the prevalence of self-reported symptoms of depression and self-reported symptoms of anxiety and determine whether associations existed between the outcomes of interest and *a priori* correlates. The prevalence of self-reported symptoms of depression was found to be 11.1% (95%CI: 7.1-15.0) and that of self-reported symptoms of anxiety was 5.3% (95%CI: 2.5-8.2). No statistically significant associations were found between the demographic correlates and either depression symptoms or anxiety symptoms, though a significant association between depression and anxiety symptoms was found ($p<0.001$). The next chapter will contextualise the above findings and place these results into our current understanding of anxiety and depression among adolescents in rural South Africa.

CHAPTER 4 DISCUSSION

4.1 General discussion

The purpose of this chapter is to discuss this study's findings, review them in light of our current understanding of adolescent mental health from the literature, specifically in rural sub-Saharan Africa, and highlight information gaps for future work globally and within rural South Africa. Contrary to the hypothesized association between biological and social factors with self-reported symptoms of depression and anxiety, this study demonstrated that the biological and social factors under investigation have no statistically significant relationship with the latter; however, the analysis found a strong correlation between self-reported symptoms of depression and anxiety. Our findings although, contrary to the hypothesis are still evident of the presence of self-reported symptoms of depression (11.1%) and anxiety (5.3%), thus suggesting the need for further investigations exploring other mental health correlates included in the bio-psychosocial framework *(Figure 2).*

4.2 Overall Prevalence of Self-reported symptoms of depression

The current prevalence finding of symptoms in 11.1% (95%CI: 7.1-15.0) of the rural South African adolescent population residing in these two villages are less than the range reported (21.1-31.3%) which was reported by Nyundo and colleagues, in a study of adolescents (10-19 years old) carried out in seven sub-Saharan countries (Nyundo *et al.*, 2019). The difference in prevalence could emanate from the data collection tools used and the duration of the studies. Whilst the current study administered the PHQ-9, which collects data for the previous week, Nyundo and collegues administered the 6-Item Kutcher Adolescent Depression Scale (KADS-6) which collected data for the past week, although their outcome of interest and suicidal ideation covered a 12 months period. That said, the present study's prevalence figures are

slightly higher than the 9.4% which was reported in an urban/rural study in South Africa of slightly older adolescents (15-19 years) within the rural-based participants compared to their urban counterparts who had a prevalence of 14.6% (Ajaero, Nzeadibe and Igboeli, 2018). Ajaero and collegues used the data from the National Income Dynamics Study (NIDS) and had a large sample size 3751 (15-19-year-olds) which allowed their study to focus on several potential determinants including, individual income, race and province of residence allowing for juxtaposition with other sites within their study whereas the current study looked at SES at a household level. Similar adolescent studies of mental health measures in Agincourt reported varying depression and anxiety prevalence, with Cortina and colleagues reporting a joint prevalence of depression and anxiety of 14.1% (95%CI: 14.05-14.15) among 10-12 years old primary school-going pupils (Cortina *et al.*, 2013), while in the same setting Goin and colleagues reported a baseline prevalence of 18.2% among adolescent girls and young women (13-21 years old) who were part of a randomised trial of a cash transfer conditional on school attendance to reduce HIV acquisition (Goin *et al.*, 2021). It is known that HIV is associated with depression and anxiety (Bernard, Dabis and De Rekeneire, 2017). The difference between our study and that of Cortina and colleagues' study could be because the latter collected data from teachers which included the children's behavioural and emotional difficulties, thus gaining an insight into an unbiased view of the children's mental health. Unlike the PHQ-9, the data collection tool that was used, the Youth Self Report (YSR), enabled the children to not only self-report on their emotional problems but also information on post-traumatic stress and perception of the school environment, where 23.9% (95%CI: 23.86-23.94) reported post-traumatic symptoms and 23% reported feeling unsafe at school, which could have compounded to higher levels of depression and anxiety reported (Cortina *et al.*, 2013). By combining depression and anxiety into a single measure as done by Cortina and colleagues, the comparison of that study's findings with the present study's findings does not provide a perfect

one-to-one match and may also account for some of the observed differences. In light of these differences, further studies exploring the various tools used to screen for symptoms of depression and anxiety in a rural South African context may be warranted.

4.3 Correlates of Depression

4.3.1 Biological correlates

4.3.1.1 Sex

Despite a general consensus that females are more prone to depression than males, there has not been a convincing study that clearly identifies why this occurs, and nor have biological studies explained the sex difference, although it is thought that one's biological makeup plays an important role in the development of depression. Although, females in the present study report a higher prevalence (13.2%), than males (9.2%), this difference is not significant. These findings of non-significant differences between sexes are similar to Gao and colleagues when exploring the prevalence of depression among freshmen undergraduate students at 15 Chinese universities. That said, they did find, albeit non-significant, a higher prevalence of depression among male students (32.41%) than females (32.39%), though important to note that Gao and colleagues' study benefited from a larger sample size (Gao, Ping and Liu, 2020). Contrarily, Ajaero and colleagues reported statistically significant differences by sex in their South African study carried out using data from the National Income Dynamics Study (NIDS). Comparing the prevalence of depression among urban and rural adolescents (15-19 years old), rural female participants reported a significantly higher prevalence (10.33%) than their rural male counterparts (8.44%) (Ajaero, Nzeadibe and Igboeli, 2018). These mixed findings suggest further research is needed to clarify the impact of sex on the prevalence of common mental disorders. Furthermore, more studies need to be carried out to shed light on why females generally report a higher prevalence of poor mental health outcomes than males. Such future

lines of inquiry can include important potential correlates such as gender-based violence, sexual abuse, teenage pregnancies, societal gender norms and socialisation (Harrison *et al.*, 2015).

4.3.1.2 Age

Few previous African studies on adolescent mental health have looked at the association between age and mental health explicitly; however, a study that compared depressive symptoms among students aged 11, 12 and 13 years in the United States reported a direct relationship between the two, with older adolescents reporting higher levels of depression (Saluja *et al.*, 2004). Similarly, Nyundo and colleagues reported that older adolescents (15-19 years old) showed higher prevalence compared to younger ones (10-14 years) in Sub-Saharan Africa. However, contrary to the above scholars, this study, found an inverse relationship between self-reported symptoms of depression and age with the youngest age group reporting the highest prevalence (13.1%), while the oldest 18-19 years old reported the lowest (8.1%)levels. The inverse relationship in the current study could be explained by the tendency of older adolescents to seek social support from family and peers (Perzow *et al.*, 2021). Younger children might not have fully developed the capacity to fully utilise emotionally focused strategies in problem-solving, compounded with the new pressures of making new friends and the introduction of extra-curriculum activities as they start secondary school (14-15 years) may render them vulnerable to stress and consequently depression (Washington, 2009) .

4.3.2 Social correlates

4.3.2.1 Educational level at the time of this study

Several scholars have postulated that increased educational attainment has a protective effect against poor mental health (Das *et al.*, 2007); contrarily to these findings, the current study reports lowest grade (1-5) has the highest prevalence of depression 16.1%, though not statistically significant. The current findings are consistent with the findings of a study done in South Africa using the South African National Income Dynamics Study, by Onuh and colleagues and Burns and colleagues. These studies found that those with increased educational attainment, particularly among those who had attained tertiary education, had lower odds of developing depression (Burns, Tomita and Lund, 2017; Onuh *et al.*, 2021). Similarly, Kim and colleagues in Malawian adolescents living with HIV (12-18 years old), reported that those with fewer years of schooling reported higher levels of depression when compared with those that had more years of school (OR 3.30; 95%CI: 1.54, 7.05; p.=.0051)(Kim *et al.*, 2015). In our context, it is possible that as young people attain higher education, they in turn acquire a wider social network, better developed cognitive skills as well as improved psychological coping mechanisms with a better locus of control and self-efficacy (Schwarzer and Warner, 2013).

4.3.2.2 Socioeconomic status and food security status

Lower socioeconomic status and food insecurity are believed to be associated directly or indirectly with poor mental health (Pryor *et al.*, 2016; Jones, 2017). This notion is supported by Hatcher and colleagues whose findings suggest that household hunger increased the odds of depressive symptoms (OR=1.57; 95%CI 0.57-2.57; p=0.002) in a study aimed at investigating the effects of poverty on young adults between the ages of 18 and 30 years in two peri-urban South African settlements (Hatcher *et al.*, 2019). Similarly, Goin and colleagues reported a higher prevalence of depression (10.1%) among HIV-positive, food insecure

adolescents (13-21 years) than HIV-positive food secure participants (7.7%) in the same setting as the present study (Goin *et al.*, 2021). The current study found no correlation between one's socioeconomic status (p=0.71) and food insecurity status (p=0.43), with self-reported symptoms of depression and anxiety. Results of the current study may differ from other studies because, in our study population, the food security status and socioeconomic status do not differ significantly since most of the population relies on government social and child grants and pensions (Stoner *et al.*, 2021). Resilience could also be the reason that our study outcomes are different as an adaptation to food insecurity could be considered a norm, thus not affecting the mental health (Cortina *et al.*, 2013). The Agincourt population has long since resorted to supplementing their dietary needs using their environmental resources to produce marula jam, brew traditional marula beer and harvest wild herbs and fruits (Hunter, Twine and Patterson, 2007).

4.3.2.3 Home Living arrangements

Disruption in traditional family structure can lead to mental health risks for young children and adolescents (Behere *et al* 2017). This study, however, has found that home living arrangements have no statistically significant relationship with the prevalence of depression (p>0.33). Those living with both parents have the highest prevalence of depression (12.6%; 95%CI: 6.10-19.14). This is in contrast to an Australian study by Perales and colleagues about family structure and childhood mental illness that found children (4-17 years old) from traditional families were less than half as likely to suffer from depression as those coming from single parented homes (1.7% [95%CI: 1.3-2.1] versus 5.5% [95% CI: 4.2-6.8], respectively) (Perales *et al.*, 2016); thus supporting the narrative that traditional families play a protective role in mental health issues (Avanci *et al.*, 2007). Davids and colleagues in their Western Cape study concluded that in terms of adolescents' psychological needs, both one and two-parent families

played a significant role as long as there was a secure parental foundation (Davids *et al.*, 2016). Parents play a crucial role in fostering adolescents' health-seeking behaviour and their presence can help adolescents in accessing mental health services. Our study participants who do not stay with any parent report the lowest prevalence of depression symptoms, possibly because there are many child-headed families due to orphanhood because of HIV and also because of the normalcy of outmigration by parents into cities to find employment thus leaving the children alone in the rural areas. Although orphans are taken up by other family members upon the death or migration of their parents, our study was measuring the presence of one or both parents in the household, not of caregivers or extended family

4.3.2.4 Media (Screen time)

Studies have reported differing findings when it comes to an association between screen time and depression. Several studies have reported an association between screen time and depression (Kremer *et al.*, 2014; Maras *et al.*, 2015) as supported by Li and colleagues who found that found high levels of TV and digital media to be associated with higher levels of depression and anxiety among Canadian adolescents (mean age =11.3 years) (Li *et al.*, 2021). Similarly, Boers and colleagues in a 4-year longitudinal cohort study of repeated exposure and outcomes also reported that increased screen time among children (mean age=11.3 years) was directly associated with increased depressive symptoms every year (Boers *et al.*, 2019). However, our study has found no association between screen time and self-reported symptoms of depression p=0.60 as supported by other studies that also reported no evidence of an association between screen time and depression (Hume *et al.*, 2011; Casiano *et al.*, 2012). The differences in our study findings could be explained by the differences in the time spent and content that our participants will be watching; it may be that our participants are watching series, dramas or listening to music and not being on Instagram or other social media platforms

which are known to influence self-esteem, hence invoking senses of insecurity resulting in depression and anxiety. These considerations should be included in future studies that explore media in this rural setting.

The current study participants all spend less than 4 hours of screen time per week compared to those in other studies who spent 5.33±3.83 hours within the urban population and 5.18±3.99 hours (Tomaz *et al.*, 2020) and up to 8 hours in Maras and colleagues' study in Canada (Maras *et al.*, 2015). This may in part be due to the fact that our rural adolescent population do not have free or highly subsidised data compared to first world countries like Canada, so the gadget (tv or phone), may be shared among household members, hence controlling and limiting the type of content that they have access to. There is a need for future studies to focus on the access and type of device available to rural South African adolescents.

The same potential correlates namely *Biological* (sex and age) and *Social* (educational level, living arrangements, socioeconomic and food security status and screen time) which were investigated for self-reported symptoms of depression were also investigated for self-reported symptoms of anxiety and the results are presented below.

4.4 Overall prevalence of Self-reported symptoms of anxiety

The prevalence of anxiety symptoms among Agincourt adolescents is slightly higher (5.3%) than the global adolescent anxiety estimates of 3.6% among 10-14 year-olds and 4.6% among 15-19 year-olds (World Health Organization, 2017). In other similar adolescent studies among perinatally HIV infected adolescents (9-19-year-olds), undertaken in Johannesburg, the prevalence was higher (7%) than in the current study. These results, although slightly higher, are likely to be explained by the fact that the study population were people leaving with HIV and were recruited from a clinic setting (West et al.,2019), hence, the respondents had potential

stressors resulting in higher levels of anxiety. Four years before this current study, Cortina and colleagues reported a combined depression and anxiety prevalence of 14.1% (95%CI: 14.5-14.1) within the same Agincourt setting, whilst investigating psychological problems in school settings using data collected from both the children (10-12 years) and their teachers on children's behavioural and emotional difficulties. The variability between the current and aforementioned studies could be because the current study dichotomized anxiety and depression whereas the former reported a joint prevalence. The involvement of teachers could have also aided in the collection of more information as they are believed to play an important role in identifying and supporting mental health issues among students (Mazzer and Rickwood, 2014). Having established the prevalence of self-reported symptoms of anxiety among adolescents in the Agincourt area, we discuss the correlates below.

4.5 Correlates of self-reported symptoms of anxiety

4.5.1 Biological correlates

4.5.1.1 Sex

Several studies have reported sex differences in the prevalence of anxiety disorders but, within a general consensus claiming that females report a higher prevalence than males; however, considerably little is known about how sex influences this difference (Gao, Ping and Liu, 2020). This current study reports contrary finding where males reported a higher prevalence of anxiety (6.2%; 95%CI: 2.0-10.3%) than females (4.4%; 95%CI: 0.5-8.2%; p=0.89). However, the difference by sex was not statistically significant. Similarly, difference by sex was reported within the same Agincourt setting by Cortina and colleagues who reported a higher prevalence among females (10.15%) than males (9.82%) but with no statistically significant difference (Cortina *et al.*, 2013). Higher risk OR 1.84 (95%CI: 1.46-2.33), of having CMDs (depression and anxiety) for females was also reported by Bantjes and colleagues in their study of first-

year students (18 years and older) in post-apartheid South Africa. They attributed this difference to the fact that females face a higher risk of being exposed to interpersonal violence, sexual abuse, being at the lower end of the social hierarchy and gender norms that put a strain on women (Bantjes *et al.*, 2019). A previous study by Memik and colleagues also reported sex differences in the prevalence of anxiety among Turkish adolescents (mean age = 12.59 years old) with boys reporting slightly higher scores of social anxiety (45.28 ±12.99) than girls (43.18 ±13.58), probably due to social pressures exerted upon the Turkish boys to participate more in social engagements (Memik *et al.*, 2010). Given the levels of poverty in rural South Africa, males in our study may be faced with the uncertainty of looking for employment and possibly migrating to cities for them to escape rural economic hardships and offer financial assistance back home (Zulu *et al.*, 2011).

4.5.1.2 Age

Of the various studies that undertook investigating age as a potential predictor of anxiety, few significant differences by age group have been reported (Dadds *et al.*, 1997; Barrett, 2010; Renko, 2020). Self-reported symptoms of anxiety by age group in this study shows an inverse relationship, with younger adolescents experiencing higher levels (8.3%; 95%CI: 2.30-14.37) than older adolescents (3.5%; 95%CI: 0.47-7.45). Despite a clear inverse pattern, this relationship was not statistically significant (p=0.46). Contrary to the current findings, Kuringe and colleagues examining anxiety among adolescent girls (15-23 years) found that age was significantly (p=0.043) associated with anxiety, where younger (15-19 years) ages reported a lower prevalence (28.7%) than the older (20-23 years) adolescent women (32.2%), attributing the differences to different social situations such as marriage and becoming a parent in the older group (Kuringe Id *et al.*, 2019). These factors are likely different from the present study's setting where the younger adolescents reported higher levels of anxiety probably due to the

transition into puberty, body image affecting self-esteem as well as the pressure of starting high school (Petersen *et al.*, 1993)

4.5.2 Social correlates

4.5.2.1 Educational level at the time of this study

Kuringe and colleagues reported a significant relationship between educational level and anxiety among adolescent women aged 15-23 years with those having higher education having higher odds (1.36; 95%CI 1.07-1.74) of having anxiety symptoms than those who had no formal or incomplete primary school (p=0.039) (Kuringe Id *et al.*, 2019). However contrary to these findings, our current study reports an inverse pattern in the prevalence of self-reported symptoms of anxiety, with the lowest grade (1-5) having the highest prevalence (9.7%; 95%CI: 2.11-17.25), compared to the highest grade (9 & above) reporting the lowest levels (3.5%, 95%CI: 1.32-7.88), consistent with the notion that higher educational attainment is associated with better mental health (Mcfarland and Wagner, 2016). Despite this result, educational level was not found to have a significant relationship with self-reported symptoms of anxiety (p=0.36). Since this current study is cross-sectional, the inverse relational findings maybe be just a snapshot of baseline statistics, suggesting the need for a follow-up analysis to establish the nature of education and anxiety correlation as evidenced by Bjelland and colleagues' European study that reported an initial association between low educational levels with anxiety but after a longitudinal analysis education was found to be protective (Bjelland *et al.*, 2008).

4.5.2.2 Socioeconomic status and food security status

Socioeconomic status and low food security are known to be risk factors for both physical and mental health (Hanson and Olson, 2012; Perez-Escamilla, Pinheiro de Toledo Vianna and de Toledo Vianna, 2012; Abrahams *et al.*, 2018); however, the results of this study showed no

relationship between socioeconomic status (p=0.94) and food security status (p=0.16) with self-reported symptoms of anxiety. Contrary to our findings of no association, Madasu and colleagues in an adolescent (10-19 years old) study in northern India reported the contrary: low socioeconomic status was associated with a higher prevalence of anxiety where those in the lower status were found to have double the odds of having anxiety compared to those who belonged to the upper class (OR 2.2; 95% CI 1.3–3.7; p.= .003) (Madasu *et al.*, 2019). Similarly, a Cape Town study on mental health inequality among adolescents (14-15 years) also reported that those in the lowest wealth quintile had the highest odds (OR=1.72; 95%CI; 0.91-3.24) of common mental health disorders compared to those in the highest quantile (OR =1.32; 95%CI: 0.75-2.35), (Das-munshi *et al.*, 2016). The absence of association in our study could be due to improvement in the socioeconomic status of the population evidenced by modern wealth measurements such as better dwellings, ownership of cars, electric stoves, fridges and cell phones. For example, 98% of the dwellings are reported to be now built from bricks and cement (Kabudula, Houle, Collinson, Kahn, Tollman, *et al.*, 2017).

4.5.2.3 Media (Screen time)

Although the question of temporality comes into play, it is not possible to tell if participants who spend more time watching television, do so because they are anxious or if they become anxious because of watching too much television. Starosta and colleagues postulate that anxiety and depressive symptoms such as the lack of interest in socialising or social anxiety can be the driver behind increased on-screen exposure and watching tv can be used as a source of positive affect as the watcher might identify with some of the media characters (Starosta, Izydorczyk and Wontorczyk, 2021). Despite other studies reporting an association between screen time and anxiety, no previous study has really reported on the issue of temporality between the two (Teychenne, Costigan and Parker, 2015). Similarly, despite finding an inverse

relationship between time spent on the screen and anxiety in this current study where participants who spend the least amount of time (1-2 hours/day) watching television report the highest levels of anxiety (7.8%; 95%CI: 2.14-13.41), compared to those that spend most amount (> 4 hours) who have a prevalence of 4.6%, (95%CI: 0.61-9.71), our findings are not statistically significant (p=0.41).

Again, as for depression, there is further need for studies that investigate screen time and common mental health disorders to focus more on the content and establish which ones foster better mental health and which are adverse.

4.6 Association between self-reported symptoms of anxiety and self-reported symptoms of depression

Comorbidity of depression and anxiety among children and adolescents has been reported to range from 20% to 70%, (Avenevoli *et al.*, 2001). Eight (25%) of the. participants have both depression and anxiety, this association is statistically significant (p<0.001), *(Table 11).* Causes of comorbidity have been attributed to the similarity of symptoms between the two conditions, identical items on the scale of measure and common underlying risk factors (Garber and Weersing, 2010). Anxiety and depression can present symptomatically similar: characterised by common somatic complaints such as back pain, headaches, neck pain, chest pain, shortness of breath, heart palpitations, problems with sleep or appetite and fatigue, and both conditions also share psychological symptoms which manifest as real-life problems. Hence it is difficult for a sufferer to distinguish between the two fields (Dobson *et al.*, 2022).

Besides sharing common symptoms, depression and anxiety also share common risk factors namely: socioeconomic factors, psychological factors, biological predispositions, childhood trauma, stress due to illnesses, stress build-up, genetic predispositions, drugs and alcohol, and

other mental disorders (Garber and Weersing, 2010). Reddy and colleagues, whilst investigating depression and anxiety among parents of children on antiretroviral therapy in KwaZulu Natal, supported this notion where they reported a significant association (OR=4.66; 95%C1: 33.0–16.3) between the death of a child and depression/anxiety comorbidity among the bereaved parents (Reddy, Tomita and Paruk, 2020).

WHO reports that the more risk factors adolescents are exposed to, the greater their chances of developing mental health challenges. Anxiety and depression also commonly share similar age of onset at 10-14 years old due to sudden social role demands and biological changes. Pressure to conform with peers, identity exploration, relationships with peers and parents, living conditions and social exclusion are some of the risk factors of emotional and psychological disorders leading to anxiety and depression (World Health Organization, 2017).

In as much as anxiety and depression co-exist, a systematic review of 66 studies reported that generalized anxiety disorder increased the risk of all types of depressive disorders (OR = 2.582, 95%CI: 1.81-5.23) and depressive disorders increased the risk of generalised anxiety (OR = 1.876, 95%CI: 1.26-2.80)(Jacobson and Newman, 2017). Similarly, a 4-year prospective longitudinal study among adolescents aged 14-24 years by Bittner and colleagues reported that the presence of anxiety at baseline is a risk factor for the development of depression ($p<0.05$) (Bittner *et al.*, 2004).

The similarity of symptoms, age at the time of onset, bidirectionality of the relationship, as well as similarity of risk factors could be the reason that the significance of the relationship between self-reported symptoms of anxiety and self-reported symptoms of depression exist in this study. Further research is needed to better understand and explain this complicated relationship.

4.7 Study strengths and limitations

4.7.1 Strengths

Since the Agincourt Health and socio-Demographic Surveillance System was established three decades ago in the Bushbuckridge sub-district of Mpumalanga Province, this allows for longitudinal research and can facilitate the carrying out of various studies including accurate knowledge of the population culture and trends allowing for generalizability of findings. The staff that collects the data are well trained and have ample experience in data collection, ethics as well as community relations. The use of prospectively collected individual and household data such as food security and socioeconomic status facilitates for a less expensive way to carry out this research and this also reduces selection bias. Being a population-based study design it is likely to yield more accurate prevalence estimates and it allows for purposive sampling of participants ensuring that the inclusion and exclusion criteria are well met.

Anxiety and depression are normally studied together as common mental health disorders but this study has managed to dichotomise the two and report on their separate prevalences in Agincourt. This juxtaposition paints a clearer picture for policymakers and stakeholders when considering policies for mental health. Another strength of this study is the use of globally and nationally validated data collection tools, namely the Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder-7 (GAD-7) scales, which report scores of severity.

4.7.2 Limitations

The study was not without limitations and the following are noteworthy: our sample size was relatively small and small samples make drawing conclusions difficult and can also affect the reliability of the study. Being a secondary data analysis, some variables such as past trauma, genetics, prior physical chronic illnesses, family relations and levels of resilience could have been investigated but were not available. Geographically the study is limited only to adolescents residing in rural north-eastern South Africa, thus its

generalisability is quite limited. Due to the vast spectrum of the *a priori* correlates of mental health and the secondary nature of this research, all of the correlates couldn't be covered by this current study, hence the need for more work that will attempt to investigate different correlates.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Recommendations

Based on this study, there is evidence of the prevalence of anxiety (5.3%) and depression (11.1%), among adolescents, thus further research should be conducted, which should include, *inter alia*, the following analyses:

- Prevalence of depression and anxiety in adolescents born to parents who suffer from depression to establish genetic predisposition to mental health disorders among the adolescent population. That said, given similar environmental and social circumstances between parent and offspring, and relating to the biopsychosocial framework, future work should seek to untangle the likely intricate interplay between parents and children with common mental disorders.

- Since the current study used data only from self-reported questionnaires, another angle to explore would be to involve parents and caregivers in the reporting of concerning behavioural and emotional difficulties as the first step to comprehensive mental health data collection. This will also mobilise support from parents/caregivers once they are involved in-depth in their children's mental health.

- With respect to all the investigated correlates proving to be insignificant, there is a need for a longitudinal study in a larger, perhaps more diverse, cohort of adolescents that investigates the same social and biological correlates to explore the possibility of vulnerability, resilience and development of better coping skills over some time.

- Since this study has reported comorbidity between anxiety and depression, there is need for a longitudinal study to investigate the comorbidity between depression and anxiety (to

establish the direction of temporality) to ascertain if it is anxiety that increases the risk of depression or vice versa.

Other relevant correlates not covered by this study should be included in future studies. These include peer and family relationships, childhood trauma, physical illnesses, beliefs, coping skills, cognition, domestic violence, orphanage, discrimination, upbringing in child-headed families and bullying. Incorporating these suggested factors may add to the understanding of the biopsychosocial pathways of mental health among adolescents

5.2 Conclusion

Despite relatively low prevalence figures of self-reported symptoms of depression and self-reported symptoms of anxiety, this research sheds light on the fact that these two conditions do exist within the rural South African adolescent population, although statistically significant associations between these outcomes and *a priori* correlates are not evident. These results led to the following conclusions:

- Despite empirical evidence that socioeconomic status and food security are found to be associated with mental health outcomes in other studies, this does not hold for Agincourt adolescents in this study
- Although scholars state that socioeconomic factors such as access to media and home living arrangements may affect health and quality of life, our study showed that on the contrary, adolescents staying with no parents reported the lowest prevalence of depression and anxiety, thus suggesting that the traditional family structure does not necessarily foster better mental health in this context and among this population of adolescents.

- While the prevalence of anxiety and depression always differed by sex, the difference was not statistically significant. Females were not more prone to mental health problems than males in this population, as males reported a higher prevalence of self-reported symptoms of anxiety.
- Contrary to some empirical studies that report greater mental health issues with increasing age, our study reported that younger adolescents had a higher prevalence than older ones.
- Depression and anxiety have a high probability of comorbidity, which may be due to similar aetiology. This commonality of this comorbidity is supported by several previous studies and further exploration is warranted.

In conclusion, this report confirms the existence of depression and anxiety among a rural adolescent population in northeast South Africa, as well as the comorbidity of these two common mental health disorders. However, this study found no association between social and biological factors with anxiety and depression, with future work directed at mitigating and reducing this burden among rural South African adolescents warranted.

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APPENDICES

R14/49 Professor SA Norris et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M1711103

NAME: (Principal Investigator)	Professor SA Norris et al
DEPARTMENT:	School of Clinical Medicine Department of Paediatrics and Child Health Developmental Pathways to Health Research Unit Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	Health of adolescents living in rural Mpumalanga: formative work for an intervention to optimize adolescent health (baseline cross-sectional survey)
DATE CONSIDERED:	24/11/2017
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Not applicable
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	06/04/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on 3rd floor, Phillip V Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/We fully understand the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. in this case, the study was initially reviewed in **November** and will therefore be due in the month of **November** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✔" to indicate your answer)*	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING 0 + _____ + _____ + _____

=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	**Somewhat difficult**	**Very difficult**	**Extremely difficult**
☐	☐	☐	☐

Generalized Anxiety Disorder 7-item (GAD-7) scale

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all sure	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3
Add the score for each column	+	+	+	
Total Score *(add your column scores)* =				

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all _____
Somewhat difficult _____
Very difficult _____
Extremely difficult _____

Source: Spitzer RL, Kroenke K, Williams JBW, Lowe B. A brief measure for assessing generalized anxiety disorder. *Arch Inern Med.* 2006;166:1092-1097.

Household Asset Status Form

Village: | |
Dwelling: | | | | | A
Fieldworker: | | | | |
Visit Date: Y Y Y Y M M D D

s1	Is the structure still under construction?	Y = Yes; N = No	1
2	Are there plans to extend the structure in the near future?	Y = Yes; N = No	2
ASK Q3 ONLY IF Q1 = "Y"			
3	In what year was construction started?	9999 = the household moved into an existing structure	3
ASK Q4 ONLY IF Q1 = "N"			
4	In what year was the building completed?	9999 = the household moved into an existing structure	4
5	What is the construction material of the walls?	1 = Brick; 2 = Cement; 3 = Other modern; 4 = Stabilized mud; 5 = Traditional mud; 6 = Wood; 7 = Other informal	5
6	What is the construction material of the roof?	1 = Tiles; 2 = Corrugated iron; 3 = Other modern; 4 = Thatch; 5 = Other informal	6
7	What is the construction material of the floor?	1 = Tiles; 2 = Cement; 3 = Modern carpet; 4 = Wood; 5 = Other modern; 6 = Dirt; 7 = Mat; 8 = Other traditional	7
8	What is the total number of bedrooms in all structures?		8
9	What is the total number of bedrooms in the main structure?		9
10	Is there a separate kitchen?	Y = Yes; N = No	10
11	Is there a separate living/dining room?	Y = Yes; N = No	11
12	Where is the toilet facility?	1 = In house; 2 = In yard; 3 = Other house; 4 = Bush	12
13	What is the type of the toilet?	1 = Modern; 2 = VIP; 3 = Pit toilet; 4 = None	13
14	What is the main water supply?	1 = Tap in house; 2 = Tap in yard; 3 = Tap in street; 4 = Truck; 5 = Cement well; 6 = Traditional well; 7 = Pond; 8 = River; 9 = Dam; 10 = Rainwater tank; 11 = Other	14
15	What is the availability of the main water supply?	1 = Always; 2 = Most of the time; 3 = Few hours a day; 4 = Irregular, not every day; 5 = Very irregular	15
ASK Q16 ONLY IF Q14 IS NOT 1 OR 2			
16	What is the distance to the main water source?	1 = Immediate (< 50 meters); 2 = Nearby, but not immediate (50-200m); 3 = Far away (> 200m)	16
17	What is the primary source of power for light and appliances?	1 = Electricity; 2 = Battery/Generator; 3 = Solar power; 4 = Paraffin; 5 = Candles; 6 = Other	17
18	What is the primary source of power for cooking?	1 = Electricity; 2 = Gas bottle; 3 = Paraffin; 4 = Wood; 5 = Other	18
19	Is there a functioning stove in the household?	Y = Yes; N = No	19
20	Is there a functioning fridge in the household?	Y = Yes; N = No	20
21	Is there a functioning TV and/or hifi/stereo in the household?	Y = Yes; N = No	21
22	Is there a functioning video machine or DVD player in the household?	Y = Yes; N = No	22
23	Is there a functioning satellite dish in the household?	Y = Yes; N = No	23
24	Is there a functioning radio (no tape or cd player) in the household?	Y = Yes; N = No	24
25	Is there a functioning landline phone in the household?	Y = Yes; N = No	25
26	Is there a functioning cell phone in the household?	Y = Yes; N = No	26
27	Is there a functioning car or truck in the household?	Y = Yes; N = No	27
28	Is there a functioning motor bike in the household?	Y = Yes; N = No	28
29	Is there a functioning bicycle in the household?	Y = Yes; N = No	29
30	Is there a functioning animal drawn cart or sled in the household?	Y = Yes; N = No	30
31	How many cattle are owned by the household?	1 = None; 2 = 1-3; 3 = 4-10; 4 = more than 10; 5 = Cattle owned, but number unknown	31
32	How many goats are owned by the household?	1 = None; 2 = 1-3; 3 = 4-10; 4 = more than 10; 5 = Goats owned, but number unknown	32
33	How many chickens are owned by the household?	1 = None; 2 = 1-10; 3 = 11-40; 4 = more than 40; 5 = Chickens owned, but number unknown	33
34	How many pigs are owned by the household?	1 = None; 2 = 1-3; 3 = 4-10; 4 = more than 10; 5 = Pigs owned, but number unknown	34

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Food Security Status Form

Village: | |
Dwelling: | | | | | A
Fieldworker: | | | | |
Visit Date: Y Y Y Y M M D D

1	How has your household obtained Maize (Mealies / Mealie meal) over the last year? (Fill in all that apply)	Grown in own garden or homestead plot	1.1	○
		Grown by household members outside of own garden or homestead plot	1.2	○
		Purchased	1.3	○
		Borrowed	1.4	○
		Get it free (Food Aid/Food Parcel)	1.5	○
		Other	1.6	○
	If Other specify: 1.7			
2	What staple foods other than Maize (Mealies / Mealie meal) does your household often consume? (Fill in all that apply)	Rice	1.1	○
		Bread	1.2	○
		Potatoes	1.3	○
		Other	1.4	○
	If other specify: 2b			
3	Has your household grown food crops other than mealies in a **garden** on your homestead plot over the last year?	Y = Yes; N = No	3	[A]
4	**If Q3 = "Y"** which crops? (Fill in all that apply)	Fruit	4.1	○
		Vegetables	4.2	○
		Other	4.3	○
	IF other specify 4.4			
5	Has your household grown food crops other than mealies in a **field** outside of your homestead plot over the last year?	Y = Yes; N = No	5	[A]
6	**If Q3 = "Y"** which crops? (Fill in all that apply)	Fruit	6.1	○
		Vegetables	6.2	○
		Other	6.3	○
	IF other specify 6.4			
7	Have your fields/gardens produced enough crops to feed all the members of your household over the whole of the last year?	Y = Yes; N = No	7	[A]
8	**If Q7 = "N"** Why Do your fields/gardens not produce enough crops to feed all the members of your household? (Fill in all that apply)	Our fields/gardens are not large enough to produce enough food	8.1	○
		We do not have enough fertilizer	8.2	○
		We do not have enough water (rainfall)	8.3	○
		No-one available to work on the field/garden	8.4	○
		Other	8.5	○
	IF other specify 8.6			
9	**If Q7 = "N"** How do you supplement your food requirements? You may select more than one option. Write all numbers in the box. (Fill in all that apply)	Buy food from the market	9.1	○
		Relatives, friends or neighbours bring food	9.2	○
		Food aid from the government	9.3	○
		Gather food from the bush	9.4	○
		Gather edible wild foods from plot or field(e.g. guxe, mice)	9.5	○
		We manage with the food we have	9.6	○
		We sell household goods e.g. furniture to buy food	9.7	○
		We sell livestock to buy food	9.8	○
		Borrowed money to buy food	9.9	○
		Other	9.10	○
	IF other specify 9.11			

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